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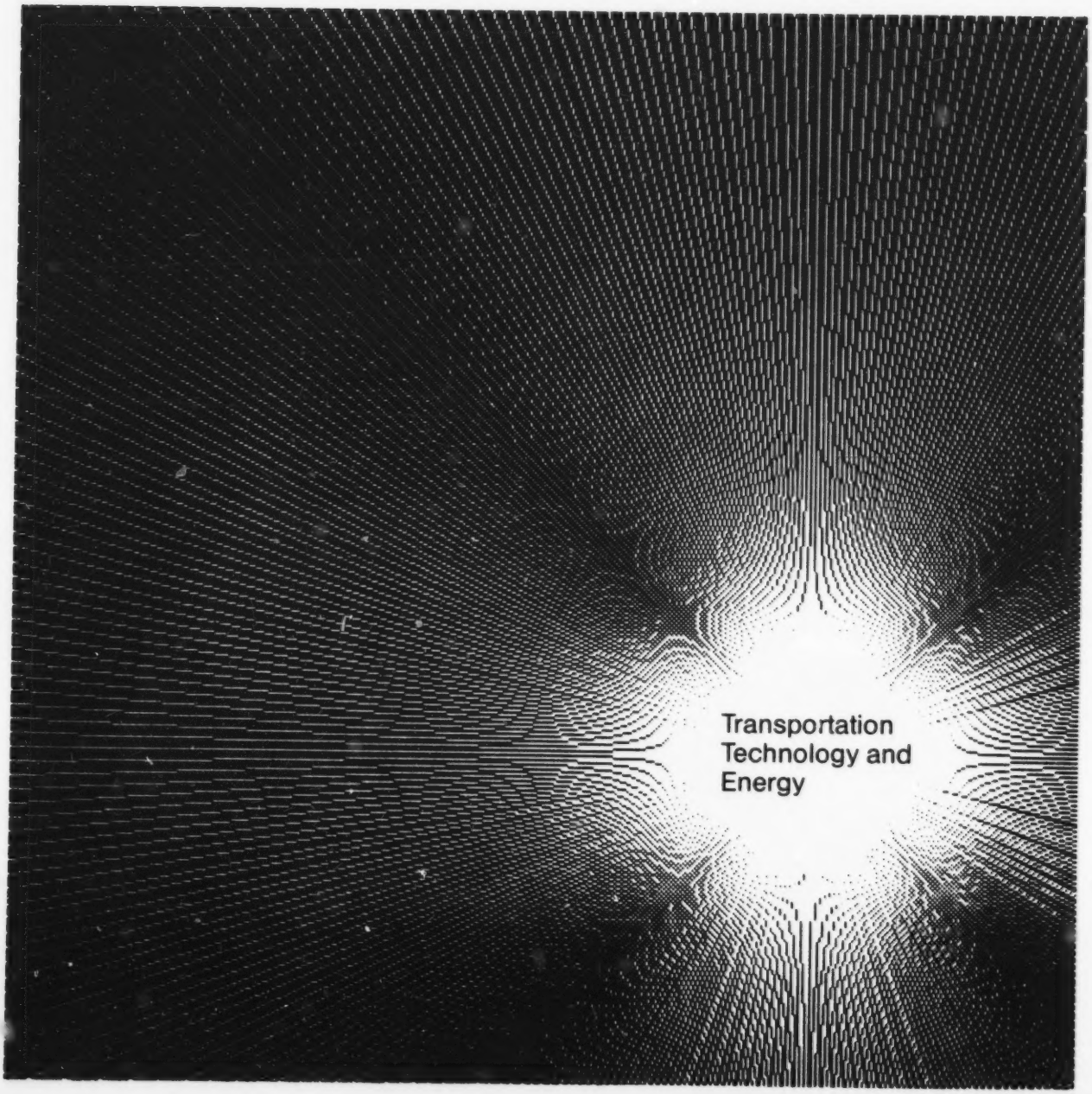

LAB-84-01

Chassis Dynamometer Facility Procedures

N. Perfect
Project Research Engineer
Technology Services Group

Issued by:
The Transportation Technology and Energy Branch
Ontario Ministry of Transportation and Communications
Hon. James W. Snow, Minister
H.F. Gilbert, Deputy Minister

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April 1984

CHASSIS DYNAMOMETER FACILITY PROCEDURES

This document replaces Report No. 79-LAB-5, "Dynamometer Facility Procedures" issued in November 1979. The facility has undergone major modification since then and many of the old procedures have changed significantly.

Standard methods for urban emissions and highway fuel economy tests remain unchanged and follow Transport Canada procedures.

Circulation is restricted to ensure that all copies may be easily traced and updated or replaced as changes become necessary.

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TECHNOLOGY SERVICES

CHASSIS DYNAMOMETER FACILITY

GENERAL PROCEDURE DYN 1

ISSUE NO: 2

DATE: May 1984

CHANGES:

DATE	ISSUE	DETAILS

MTC DYNAMOMETER FACILITY DYN 1 SHEET 1

VEHICLE & EXHAUST EMISSIONS ANALYSIS DATA SHEETS

TEST NO._____ DATE:_____

TEST TYPE:_____ SOAK TIME:_____HRS.

CUSTOMER:_____

VEHICLE:

Make:_____ MODEL:_____ LIC. No.:_____ YEAR:_____

ID No.:_____ GVW:_____kg _____lbs TRANS:_____

Odometer:_____km _____mi TIRES:_____

KERB WT:_____kg _____lb _____

ENGINE:

Type: AIR COND.: CYLS.: Cap: _____l _____in^3

Carb:_____ Fuel:_____

EMISSION CONTROL:

Cat: EGR: Air Inj: Evap. Can: PCV:

Other:_____

DYNAMOMETER:

Inertia Wt.:_____ kg _____lb Ind. Road Load:_____ kW _____HP

Act. Road Load:_____kW_____ HP Tire Press: _____ kPa_____lb/in^2

CELL TEMP:_____ °C CELL PRESS:_____ kPa HUMIDITY: _____

TEST RESULTS:

		COLD TRANS:	STABILIZED:	HOT TRANS:
DISTANCE:	(miles [km])			
FUEL USED:	(g.)			
EMISSIONS:	(g/mile [km])			
HC:				
CO:				
CO_2:				
NO_x:				

WEIGHTED EMISSIONS: (g/mile [km])

HC:_____ CO:_____ CO_2:_____ NO_x:_____

KERB IDLE:_____ rpm CO:____% HC:_____ ppm

FAST IDLE:_____ rpm CO:____% HC:_____ ppm

FUEL CONS.:

Urban:_____ Highway:_____ Combined:_____

Other:_____

REMARKS:_____

MTC DYNAMOMETER FACILITY

DYN 1 SHEET 2

TEST NO: DATE: TIME:

TEST TYPE: SOAK TIME:

VEHICLE:

DYNO: INERTIA: IND. H. P.:

CELL PRESS: mmHg (x0.13329) = kPa CELL DEW PT. = °C

CELL TEMP: °C

	MODE 1 ( )	MODE 2 ( )	MODE 3 ( )
CVS – SCF			
DIST: (COUNTS x.436)	(mi.)	(mi.)	(mi.)

ANALYZERS (0 – 10V)

AIR						
CO	R1		R1		R1	
CO_2	R1	R2	R1	R2	R1	R2
HC	R2	R4	R2	R4	R2	R4
NO_x	0-100		0-100		0-100	
EXHAUST						
CO	R	R	R	R	R	R
CO_2	R	R	R	R	R	R
HC	R	R	R	R	R	R
NO_x	0-		0-		0-	

EMISSIONS (PPM & %)

HC (PPM)	EXH. AIR
CO (PPM)	EXH. AIR
NO_x (PPM)	EXH. AIR
CO_2 (%)	EXH. AIR

FUEL USED (g)

SP. GR. (g/m1)

FUEL %C

FUEL:

TECHNOLOGY SERVICES

CHASSIS DYNAMOMETER FACILITY

GENERAL PROCEDURE DYN 2

ISSUE NO: 1

DATE: May 1984

CHANGES:

DATE	ISSUE	DETAILS

GENERAL PROCEDURE DYN 2 -- FACILITY OPERATION

A/ START-UP

1/ Ensure that the main switches are ON for:

1.1/	P.A.U. circulation pump	
1.2/	Exhaust extraction system	located on south wall of
1.3/	Heat exchanger fan	instrumentation room
1.4/	CVS exhaust fan	
1.5/	Main cooling fan	located on west wall of
1.6/	Electric motor	instrumentation room
1.7/	Cooling fan brake	
1.8/	Fluid make-up pump	located on wall above
1.9/	Gas storage room fan	fluid supply tank
1.10/	Dynamometer pit fan	
1.11/	CVS main switch	on north wall of instrumentation room on right-hand side
1.12/	Air compressor	on wall beside compressor

2/ Check that heating circuit pump is running. Pressure gauge should read 15 psi or higher. If pressure falls below 10 psi, stop pump and top up system by opening stop valve in feed-line.

3/ Check that lift/roll brake is down.

4/ Drain water from air compressor reservoir and drier in instrumentation room. If moisture gauge on drier reads 90%, replace desiccant.

5/ Check that there is sufficient paper in strip chart recorder for first test at least.

6/ Start strip chart recorder drive, ensure that pen is adjusted to zero and stop drive.

7/ Check that CO alarm units on north wall of instrumentation room are plugged in, and that HC alarm units on console are switched on.

8/ During winter months, fill instrumentation room humidifier and ensure that it is operational.

9/ Turn on interlock switch for exhaust extraction system and heat exchanger fan, located on north wall of instrumentation room on right-hand side.

B/ CONTROL PANEL

This panel contains all controls and displays necessary to operate the dynamometer in any of its automatic or manual modes.

As shown in Figure 1, the panel contains the following:

- three banks of indicators, many of which are also active control buttons;
- a keyboard by which information may be entered and which also displays failure information;
- two digital meters indicating roll speed in mph and power absorbed by the power absorption unit in hp;
- four failure indicator lights;
- a switch to select front or rear roll speed indication;
- an Emergency STOP button and a key lock power switch.

The indicator lights at the upper left of the panel are "prompt" lights which illuminate to give the operator instructions. Two of them are active: "Warm Up Complete?" and "Precondition?" Pressing the button signifies an affirmative.

The lights at the lower left are active manual control buttons when the system is in the "Diagnostic", or manual control modes only. Otherwise, they are inactive. Those labelled "Flywheel", light when the corresponding flywheel is engaged, enabling the operator to check that the engaged inertia corresponds to the test requirement.

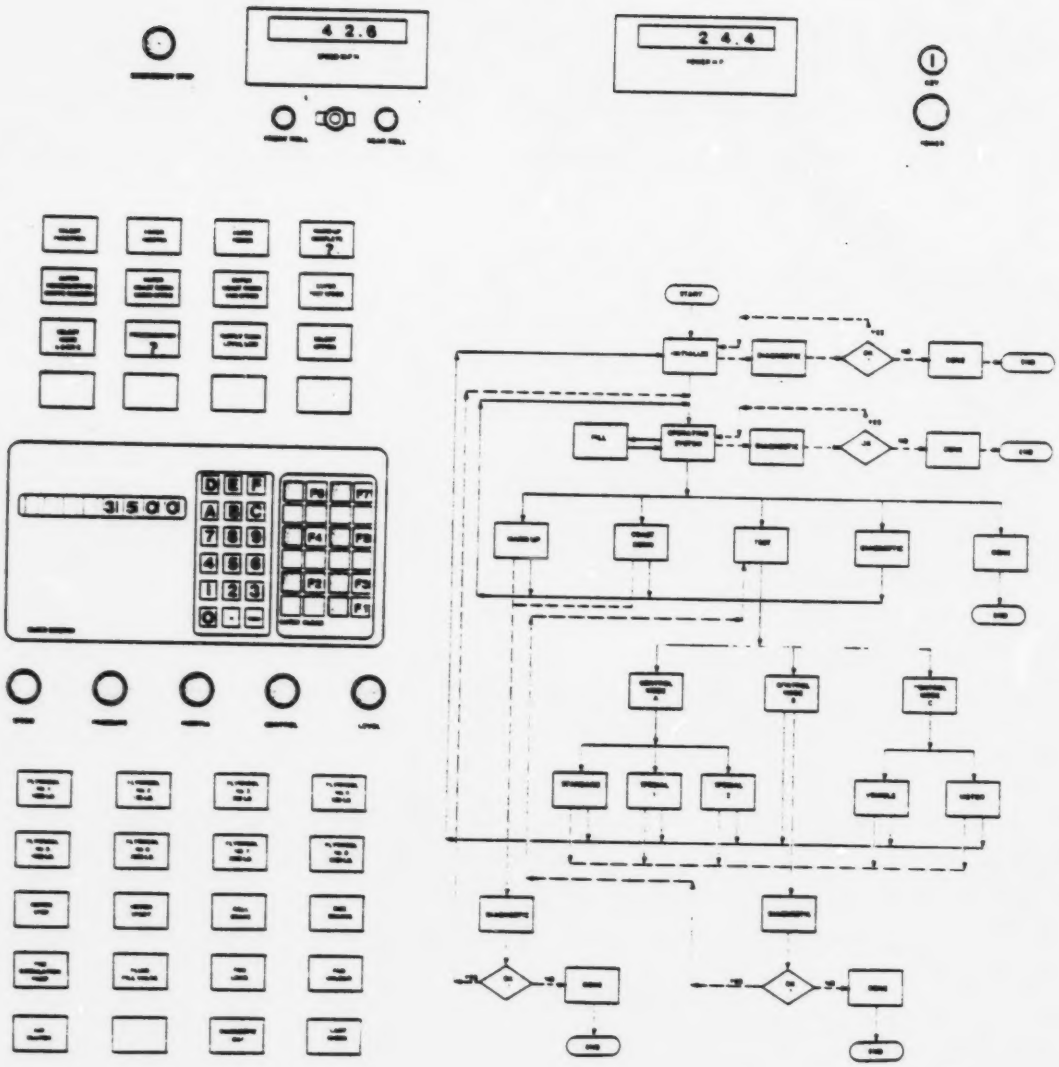

Figure 1/ Panel

On the right-hand side of the panel are the "function" lights which indicate which mode the system is in. Some are active buttons and enable the operator to select modes of operation as prompted.

Start-Up:

1/ Turn on (clockwise) the power key lock at the top right-hand corner of the panel. The green "Power" indicator and the "Initialize" function button will light. After a pause, the "Initialize" light will go out.

2/ If the fluid level in the header tank is low, the "Fill" function indicator will light until the level is correct. It will then go out and the function button "Operating System" and prompt "Select Function" will light.

3/ The system is now in a condition to accept instructions and one of the operational functions ("Warm Up", "Coast Down", "Test", "Diagnostic" or "Done") may be selected.

4/ Depress button "Lamp Check" and ensure that all buttons and indicator lights illuminate. Replace any defective bulbs.

C/ FUNCTION "WARM UP"

The purpose of this mode of operation is to run the machine using the electric motor drive until the bearings and power absorption unit reach their normal operating temperature.

1/ Verify that control is in the "Operating System" mode. If not, press the "Initialize" button and allow the control to run through to "Operating System".

2/ Ascertain the correct inertia and total horsepower for the vehicle to be tested. Do <u>not</u> position the vehicle on the dynamometer rolls.

3/ Press function button "Warm Up". Function light "Operating System" will go out; function button "Warm Up" and prompt "Enter Inertia" will light.

4/ Key in inertia value (four-digit number) on keyboard and check entry on display. If correct, press "Enter". If incorrect, press "Clear" and enter correct value. Prompt light "Enter Inertia" will go out and prompt button "Enter Power" will light.

5/ Enter total power on keyboard and check on display. All power values must contain ONE decimal place, e.g., 8.4, 10.3, 12.0.
If correct, press "Enter". If incorrect. press "Clear" and enter correct value.
Prompt light "Enter Power" will go out.

6/ Machine will start automatically and run for 20 min at correct power and equilibrium speed. At end of 20 min prompt button "Warm Up Complete?" will light.

7/ If ready to proceed to next part of test, press button "Warm Up Complete?".
Light will go out and machine will be brought to a stop.
Control will return to "Operating System", or to "Fill" and then "Operating System".

D/ FUNCTION "COAST DOWN"

This routine runs coast down tests between two selected speeds close to, and equally disposed about 50 mph. The power absorption unit control routine constants are derived from these tests for accurate control of total absorbed power at all speeds.

1/ Verify that control is in "Operating System" mode. If not, press the "Initialize" button and allow the control to run through to "Operating System."

2/ Ascertain the correct inertia and total horsepower for the vehicle to be tested.
Do not position the vehicle on the dynamometer rolls.

3/ Press function button "Coast Down".
Function light "Operating System" will go out. Function button "Coast Down" and prompt "Warm Up Complete?" will light.

4/ If warm up routine has been completed within 1 h, press button "Warm Up Complete?"
Prompt light "Warm Up Complete?" will go out and prompt button "Enter Inertia" will light.

5/ Key in inertia value (four-digit number) on keyboard and check entry on display. If correct, press "Enter". If incorrect, press "Clear" and enter correct value.
Prompt light "Enter Inertia" will go out and prompt button "Enter Power" will light.

6/ Check that correct flywheel buttons corresponding to required inertia are lit. If not, check visually if correct flywheels are engaged.

NOTE: If inertia is less than 3000 lb, flywheel No. 6 (2000 lb) will automatically be engaged in addition to the other flywheels required.

7/ Enter total power on keyboard and check on display.
All powers must contain ONE decimal place, e.g., 8.4, 10.3, 12.0
If correct, press "Enter". If incorrect, press "Clear" and enter correct value.
Prompt light "Enter Power" will go out and prompt "Enter Torque/Speed Curve Number" will light.

8/ Enter number of torque/speed curve -- usually 1 -- on keyboard, check and press "Enter", if correct.
Prompt light "Enter Torque/Speed Curve Number" will go out and prompt "Enter Coast Down Begin Speed" will light.

9/ Enter coast down begin speed -- usually 52 -- on keyboard, check and press "Enter", if correct.
Prompt light "Enter Coast Down Begin Speed" will go out and prompt "Enter Coast Down End Speed" will light.

10/ Enter coast down end speed -- usually 48 -- on keyboard, check and press "Enter", if correct.

11/ Machine will start automatically, accelerate to equilibrium speed and perform sufficient coast downs to achieve correct total absorbed power. It will then stop and the control will return to "Operating System", or to "Fill" and then to "Operating System".

E/ FUNCTION "TEST"

There are several different modes of control available under this function. They are grouped under three main divisions; modes A, B and C, and will be dealt with in that order.

Mode A is used for most test work including urban emissions and highway fuel economy tests, air/fuel ratio tests, and any other tests which involve variable speed runs with preset power control. If the vehicle is not being preconditioned, total power absorption must be preset by function "Coast Down" prior to using control mode A.

Mode B is used when constant speed tests are required with the power absorption unit set to absorb a given power at the test speed.

Mode C may be used when the power absorbed by the power absorption unit must be manually controlled. Automatic power control is inhibited in this mode.

1/ Verify that control is in "Operating System" mode.
If not, press the "Initialize" button and allow the control to run through to "Operating System".

2/ Ascertain the correct inertia and absorbed power for the vehicle to be tested.
Position the vehicle on the dynamometer rolls.

3/ Press function button "Test".
Function light "Operating System" and prompt light "Select Function" will go out. Function button "Test" and prompt button "Enter Inertia" will light.

4/ Key in inertia value (four-digit number) on keyboard, check entry and if correct, press "Enter". If incorrect, press "Clear" and then enter correct value.
Prompt light "Enter Inertia" will go out, and prompt button "Precondition?" will light when vehicle lift/roll brake is fully down.

5/ Check that correct flywheel buttons corresponding to required inertia are lit. If not, check visually if correct flywheels are engaged.

6/ If the vehicle is to be preconditioned prior to urban emissions test, press button "Precondition?"
Prompt light "Precondition?" will go out and prompt button "Enter Power" will light.

7/ Key in required total absorbed power on keyboard and check.
All powers must contain ONE decimal place, e.g., 8.4, 10.3, 12.0.
If correct press "Enter". If incorrect, press "Clear" and enter correct value.
Prompt light "Enter Power" will go out. Function button "Test Mode A" and prompt button "Enter Option" will light.
Continue from Paragraph A10.

8/ If vehicle is not to be preconditioned, ignore prompt light "Precondition?" After a short pause it will go out and prompt button "Select Mode A, B or C" will light.

Mode A

A9/ If control mode A is required, press function button "Control Mode A".
Prompt light "Select Mode A, B or C" will go out. Function button "Control Mode A" and prompt "Select Option" will light.

A10/ For all standard test work, such as urban emissions, highway fuel economy and DYN 9 tests, press function button "Standard".
Vehicle may now be tested.

A11/ After completing all test work press function button "Initialize."
Function lights "Test", "Control Mode A" and "Standard" will go out, and control will return to "Initialize" and then to "Operating System", or to "Fill" and then to "Operating System".
NOTE: It is important that all tests be complete before re-initializing the system, as initializing discards the power control constants set by "Coast Down".

A12/ Remove vehicle when control returns to "Operating System".

Mode B

B9/ If control mode B is required, press function button "Control Mode B".
Prompt light "Select Mode A, B or C" will go out.
Function button "Control Mode B" and prompt "Enter Test Speed" will light.

B10/ Key in test speed in mph (no decimal places) on keyboard, check and, if correct, press "Enter". If incorrect, press "Clear" and enter correct value.
Prompt light "Enter Test Speed" will go out and prompt "Enter Power" will light.

B11/ Key in required power on keyboard. Check and if correct, press "Enter". If incorrect, press "Clear" and enter correct value.
NOTE: All powers must contain ONE decimal place, e.g., 8.4, 10.3, 12.0. This is the power absorbed by the power absorption unit only, NOT the total power absorbed by the machine. It will be as required at the test speed and vary as the speed under "Standard" control.
Prompt light "Enter Power" will go out.
Vehicle may now be tested.

B12/ After completing all tests press function button "Initialize". Function lights "Test" and "Control Mode B" will go out and control will return to "Operating System".
NOTE: Initializing the system discards power control constants set in Paragraph B11. Make sure all tests are complete.

B13/ Remove vehicle when control returns to "Operating System".

Mode C

C9/ If control mode C is required, press function button "Control Mode C".
Prompt light "Select Mode A, B or C" will go out and prompt "Select Option" will light.

C10.1/ If a vehicle is to be tested, press function button "Vehicle". Prompt light "Select Option" will go out and function buttons, "Control Mode C" and "Vehicle" will light. The vehicle may now be run on the dynamometer, the power absorbed being manually controlled by buttons "PAU Load" and "PAU Unload".

C10.2/ If motor drive is required, press function button "Motor". Prompt light "Select Option" will go out and function buttons "Control Mode C" and "Motor" will light. The motor may now be started and stopped by the buttons "Motor Start" and "Motor Stop". The power absorbed is manually controlled by buttons "PAU Load" and "PAU Unload."

C11/ When testing is complete, press function button "Initialize". Function lights "Test", "Control Mode C" and "Vehicle" or "Motor" will go out and control will return to "Operating System".

C12/ Remove vehicle when control returns to "Operating System".

F/ FUNCTION "DIAGNOSTIC"

Whenever complete manual control of all system functions is required, the "Diagnostic" routine should be used. It is automatically called when a malfunction arises and is useful at other times, e.g., during maintenance and calibration.

1/ Verify that control is in "Operating System" mode. If not, press the "Initialize" button and allow the control to run through to "Operating System".

2/ Press function button "Diagnostic".
Function light "Operating System" and prompt light "Select Function" will go out. All function buttons "Diagnostic" will light.
The vehicle lift/roll brake will be lowered and all flywheels will disengage.

3/ The system is now under total manual control and the control buttons may be used for any function. It is important to deactivate all functions before leaving the routine, i.e., make sure all control buttons are raised.

4/ To leave the "Diagnostic" function, press control button "Diagnostic OK".
The function lights "Diagnostic" will go out and the function buttons "Done" will light.

5.1/ If further operation is required, press function button "Initialize". Function lights "Done" will go out and system will return to "Operating System" through "Initialize" and "Fill".

5.2/ If system is no longer required, turn off (anti-clockwise) key lock power switch.

G/ FUNCTION "DONE"

This is a housekeeping function which "tidies up" the system preparatory to switching off or re-initializing after using routine "Diagnostic".

It ensures that all moving parts are stationary, the brakes are off and the PAU circulation pump is off.

1/ Verify that control is in "Operating System" or "Diagnostic" mode.

2.1/ If in "Operating System" mode, press function button "Done".
Function light "Operating System" and prompt light "Select Function" will go out.
Function buttons "Done" will light.

2.2/ If in "Diagnostic" mode, check that all control buttons are raised and press control button "Diagnostic OK".
Function lights "Diagnostic" will go out and function buttons "Done" will light.

3.1/ If further operation is required, press function button "Initialize".
Function lights "Done" will go out and system will return to "Operating System" through "Initialize" and "Fill".

3.2/ If no further operation is required, turn off (anti-clockwise) key lock power switch.

TECHNOLOGY SERVICES

CHASSIS DYNAMOMETER FACILITY

GENERAL PROCEDURE DYN 3-1

ISSUE NO: 1

DATE: May 1984

CHANGES:

DATE	ISSUE	DETAILS

GENERAL PROCEDURE DYN 3-1 -- URBAN EMISSIONS TEST PROCEDURE

An urban emissions test consists of driving a test vehicle on the dynamometer through a predetermined driving cycle, collecting a representative sample of exhaust gas and analysing it.

The emissions and fuel consumption of the vehicle are expressed as a weighted average; the emissions in grams per mile, and the fuel consumption in litres per hundred kilometres.

Before testing, the vehicle must be "preconditioned", by driving it through part of the driving cycle and then allowing it to stand or "soak" for 12 to 36 h prior to test.

The ambient temperature during precondition, soak and test must remain between 20°C and 30°C (68°F and 86°F).

Procedure:

1/ Vehicle

1.1/ Check exhaust system for leaks.
If leaks are found, repair, if possible, or reject vehicle.
Check that tailpipe is in a condition good enough to accept silicone rubber sleeve.

1.2/ Check condition of drive wheel tires.
Reject if there is insufficient tread, sidewall cracks, or bulges.
Inflate tires to 45 psi.

1.3/ Establish kerb weight of vehicle.
This is the weight with full fuel tank, oil and coolant at correct levels, but no driver or payload. Obtain by weighing or from manufacturer or other source.

1.4/ Add 300 lb to the kerb weight and select the corresponding dynamometer inertia from Table 1 for vehicles up to and including 1978, or from Table II for vehicles 1979 and subsequent.

1.5/ Obtain the correct dynamometer total absorbed power (HP_d) at 50 mph for the vehicle.

Use Table 1 for vehicles up to and including 1978. For vehicles 1979 and subsequent, HP_d must be obtained from other sources, e.g., Transport Canada, EPA, manufacturer. HP_d may be calculated -- see Appendix -- but this is not very practical; or the coast down method, as detailed in SAE Procedure J1263, may be used. If vehicle is air conditioned, increase HP_d by 10%.

1.6/ Record all vehicle data, including inertia and HP_d on DYN 1, sheet 1.

2/ Strip Chart Recorder

2.1/ Start the recorder while the dynamometer is stationary and verify that pen is at zero. Adjust as necessary.

2.2/ Use routine "Diagnostic" and motor drive to run the dynamometer up to 60 mph.

2.3/ Verify that recorder pen is on 60 mph line. Adjust as necessary.

2.4/ Stop the dynamometer and check that recorder pen returns to zero.

2.5/ Repeat 2.2, 2.3 and 2.4 sufficient times to ensure repeatability.

2.6/ Re-initialize the control system.

3/ Dynamometer

3.1/ Verify that control is in "Operating System" mode. If not, press "Initialize" button and allow control to run through to "Operating System".

3.2/ If the machine has not been run within 1 h, select "Warm Up" function as detailed in DYN 2 and allow to run through warm-up routine.

3.3/ On completion of warm up, or if machine has been used for test within 1 h, ensure that control is in "Operating System" mode and:

3.3.1/ If vehicle is to be preconditioned, position it on the dynamometer rolls.

3.3.2/ Select function "Test", "Precondition", "Standard" as in DYN 2.

3.3.3/ If vehicle is to be tested, select function "Coast Down" as in DYN 2 and allow to run through coast-down routine.

3.3.4/ When control returns to "Operating System" after the coast-down routine, position vehicle on dynamometer rolls.

3.3.5/ Select routine "Test", "Mode A", "Standard" as in DYN 2.

3.4/ Open vehicle hood and position strip chart recorder in front of driver at a suitable height to ensure ease of reading without risk of contacting hood or windshield.
Write vehicle make, model and registration number, test number, date and driver's name at start of driving cycle.

3.5/ Place strip chart recorder switch box, headset and emergency fire extinguisher control box in the vehicle conveniently close to the driver.

3.6/ When vehicle lift/roll brakes have lowered, position vehicle restraints:

3.6.1/ For rear wheel drive vehicles, secure chocks on transverse beam approximately one inch in front of front wheels. Check that beam hold down bolts and chock securing bolts are tight.

3.6.2/ For front wheel drive vehicles, secure chocks on transverse beam approximately one inch in front of rear wheels.

Attach chain hoists to vehicle near each front wheel, and to eye bolts secured to second transverse beam in front of front wheels, such that chains cross. Chains should not be tight but have a little slack to allow some amount of sideways movement.

3.7/ For vehicles on precondition, place exhaust extraction tubing bell mouth over exhaust tail pipe(s) and check that extraction fan is running.
For vehicles on test, install and clamp suitable silicone rubber adapter on tail pipe(s) and connect to CVS unit through flexible steel tubing.

3.8/ Turn on main cooling fan and adjust speed so that upper duct air speed gauge reads 1800 to 2000 ft/min. Set cooling/recirculation air controls so that test bay temperature is maintained as closely as possible to 25°C during test.

3.9/ For precondition, drive the vehicle through the cold transient and stabilized portions of the urban driving cycle only.
For test, drive the complete urban cycle as in DYN 4-1, in conjunction with the CVS operator.

3.10/ On completion of the driving cycle either:

3.10.1/ Proceed to the highway fuel economy test, or any other test work requiring the same dynamometer control settings.

3.10.2/ Reset control to "Initialize" and dismantle exhaust tubing, remove strip chart recorder and other test equipment. Close hood and when control reaches "Operating System", remove vehicle from rolls.

3.11/ If all testing is complete, reduce tire pressures to correct pressure as given by manufacturer.
NOTE: Allow tires to cool down before final pressure adjustment.

TABLE 1/ DYN 3-1

Loaded vehicle weight (lb)	Equivalent inertia weight (lb)	Road load power at 50 mph (HP_d)
Up to 1125	1000	5.9
1126 to 1375	1250	6.5
1376 to 1625	1500	7.1
1626 to 1875	1750	7.7
1876 to 2125	2000	8.3
2126 to 2375	2250	8.8
2376 to 2625	2500	9.4
2626 to 2875	2750	9.9
2876 to 3250	3000	10.3
3251 to 3750	3500	11.2
3751 to 4250	4000	12.0
4251 to 4750	4500	12.7
4751 to 5250	5000	13.4
5251 to 5750	5500	13.9
5751 and above	5500	14.4

NOTE:

1/ Loaded vehicle weight is curb weight (measured or supplied by manufacturer) + 300 lb.

2/ For vehicles with air conditioning increase road load power (HP_d) by 10%.

TABLE 2/ DYN 3-1

Loaded vehicle weight (lb)	Equivalent inertia weight (lb)
Up to 1062	1000
1063 to 1187	1125
1188 to 1312	1250
1313 to 1437	1375
1438 to 1562	1500
1563 to 1687	1625
1688 to 1812	1750
1813 to 1937	1875
1938 to 2062	2000
2063 to 2187	2125
2188 to 2312	2250
2313 to 2437	2375
2438 to 2562	2500
2563 to 2687	2625
2688 to 2812	2750
2813 to 2937	2875
2938 to 3062	3000
3063 to 3187	3125
3188 to 3312	3250
3313 to 3437	3375
3438 to 3562	3500
3563 to 3687	3625
3688 to 3812	3750
3813 to 3937	3875
3938 to 4125	4000
4126 to 4375	4250
4376 to 4625	4500
4626 to 4875	4750
4876 to 5125	5000
5126 to 5375	5250
5376 and above	5500

TABLE 2/ DYN 3-1 (Cont'd)

Loaded vehicle weight (lb)	Equivalent inertia weight (lb)

For light duty trucks with loaded weights below 5375 lb the above section shall be used. Above 5375 lb loaded weight the following section applies:

5376 to 5750	5500
5751 to 6250	6000
6251 to 6750	6500
6751 to 7250	7000
7251 to 7750	7500
7751 to 8250	8000
8251 to 8750	8500

The dynamometer must not be used for vehicles above 8750 lb loaded weight or having a driving axle load greater than 4000 lb.

DYN 3-1
APPENDIX

For 1979 model year and subsequent, the inertia weights must be selected from Table 2

For light duty vehicles and light duty trucks the road load power (hp_d) is determined from the expression.

$$HP_d = 2\ 48 + 4\ 78 \times 10^{-1} + 1\ 73 \times 10^{-2}\ AS + 1\ 56P + 2\ 17 \times 10^{-4}\ TW$$

where A = vehicle frontal area (ft^2)
S = vehicle shape factor
P = vehicle protuberance factor
T = tire type (bias ply, T = 0, radial ply, T = -1)
W = equivalent inertia weight (lb)

1/ Vehicle shape factor, S

This is defined as:

$$S = \sum_{i=1}^{6} a_i s_i$$

where the factors a_i are.

$a_1 = 2$
$a_2 = 1$
$a_3 = 1$
$a_4 = 1$
$a_5 = 1$
$a_6 = 2$

and the s_i factors are defined below:

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The shape factors consider the front deck; the front, rear and side surfaces; and the transitions from these surfaces to the other vehicle surfaces.

Front deck: the horizontal or inclined surface extending forward from the foremost point of the windshield.

Rear deck: includes all horizontal or inclined surfaces extending rearward from the rearmost point of the windshield.

Front surface: the vertical or nearly vertical surface at the front of the vehicle.

Side surface: the vertical or nearly vertical surface in a frontal view of the vehicle.

Rear surface: the vertical or nearly vertical surface at the rear of the vehicle.

The term s_1 describes the longitudinal sections of the front deck and their transition into the front surface (side view of vehicle front deck).

$s_1 = -1$ where the projected area of the front deck, which is inclined less than 30° from the horizontal is at least 33% of the projected frontal area below the windshield to body transition.

$s_1 = -1$ where the transition from the front deck to the front surface has a radius of curvature greater than eight inches in all longitudinal sections. (The curvature must subtend an angle of one radian or greater to be considered).

$s_1 = 0$ for vehicles not satisfying the above criteria, but having a front deck to front surface transition greater than four inches

and equal to or less than eight inches in all horizontal sections. (The curvature must subtend an angle of one radian or greater to be considered).

s_1 = +1 for all other vehicles.

The term s_2 describes the transition between front and side surfaces through horizontal sections (top view of front surface).

s_2 = -1 where the transition has a radius of curvature greater than eight inches in all horizontal sections. There must be no protuberances on this surface.

s_2 = 0 where the transition has a radius of curvature greater than four inches in all horizontal sections. There must be no protuberances on this surface.

s_2 = +1 for all other vehicles.

The term s_3 defines the windshield surface and the transition of this surface to the side surfaces through horizontal sections (top view).

s_3 = -1 where the radius of curvature of the transition from the centre of the windshield to the side surface is greater than eight inches.

s_3 = 0 where the radius of curvature is greater than four inches but equal to or less than eight inches.

s_3 = +1 for all other vehicles.

The term s_4 describes the angle of inclination from the horizontal of the windshield at the centre line.

s_4 = -1 where the angle of inclination is less than 30° from horizontal.

s_4 = 0 where the angle of inclination is less than 60° but equal to or greater than 30° from horizontal.

s_4 = +1 for other angles.

The term s_5 describes the transition of the side surface to the rear surface through horizontal sections (top view of rear of vehicle).

s_5 = -1 when at least 33% of the rear projected area of the vehicle has lines of intersection with the horizontal longitudinal planes which from an angle of less than 20° from the longitudinal axis of the vehicle.

s_5 = 0 when at least 20% but less than 30% of the rear projected area of the vehicle has lines of intersection with horizontal longitudinal planes which form an angle of less than 20° with the longitudinal axis of the vehicle.

s_5 = -1 for all other vehicles.

The term s_6 describes the longitudinal sections of the rear deck of the vehicle and their transition into the rear surface (side view of rear deck).

s_6 = -2 where greater than 50% of the projected rear areas of the vehicle have lines of intersection with vertical longitudinal section planes which are inclined less than 20% from the horizontal.

s_6 = -1 where more than 33% but less than 50% of the projected rear area of the vehicle has lines of intersection with vertical longitudinal section planes which are inclined less than 20° from the horizontal.

s_6 = 0 when 33% of the projected rear area of the vehicle has lines of intersection with vertical longitudinal section planes which are inclined less than 45° from the horizontal.

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s_6 = +1 for vehicles not satisfying above criteria but having closed rear surfaces.

s_6 = +2 for vehicles with open rear surfaces.

2/ Protuberance factor, P

This is defined as:

$$P = \sum_{i=1}^{7} b_i p_i$$

where the factors b_i are:

b_1 = 1.00
b_2 = 0.200
b_3 = 0.091
b_4 = 0.215
b_5 = 0.250
b_6 = 0.250
b_7 = 0.500

and terms p_i are:

p_1 = if vehicle is equipped with a roof rack.

p_2 = the number of protruding aerials.

p_3 = the number of hood ornaments protruding more than 0.375 in. from the hood surface.

p_4 = The number of mirrors on the vehicle which are not located directly in the vehicle air stream, having aerodynamic shape (i.e., the longitudinal dimension exceeds the maximum lateral dimension).

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p_5 = the number of mirrors not located in the air stream and not meeting the criterion of p_4.

p_6 = the number of mirrors located in the air stream and having aerodynamic shape (see p_4).

p_7 = the number of mirrors not meeting the criteria of p_4, p_5 or p_6.

NOTE:

Terms p_1, p_2 and p_3 shall be zero if the vehicle is not equipped with such items.

For terms p_4 through p_7, a mirror shall be considered to be in the vehicle air stream unless it is entirely behind the projection of the windshield surface and within eight inches of the vehicle side.

TECHNOLOGY SERVICES

CHASSIS DYNAMOMETER FACILITY

GENERAL PROCEDURE DYN 3-2

ISSUE NO: 1

DATE: May 1984

CHANGES:

DATE	ISSUE	DETAILS

GENERAL PROCEDURE DYN 3-2 -- HIGHWAY FUEL ECONOMY TEST PROCEDURE

In the highway fuel economy test (HWFET), the vehicle is driven on the dynamometer through two consecutive identical driving cycles. The second cycle commences 15 sec after completion of the first. The engine is allowed to idle between cycles.

The exhaust gas is sampled during the second driving cycle only and emissions and fuel consumption are calculated from the analysis.

Procedure:

1/ If the vehicle has performed the urban emissions test within 3 h:

1.1/ If the dynamometer has been warmed up and correctly set for the vehicle within 1 h, place the vehicle on the rolls (if not already there) connect up to CVS unit and perform HWFET as in DYN 4-2, in conjunction with CVS operator.

1.2/ Otherwise, warm up and coast down dynamometer as for urban emissions test DYN 3-1 and then install the vehicle for HWFET, ensuring that the three-hour limit is not exceeded.

2/ If the vehicle has not been tested within 3 h:

2.1/ Follow procedure DYN 3-1 up to and including Paragraph 3.8.

2.2/ Drive the cold transient and stabilized portions of the urban emissions test.

2.3/ Drive the HWFET as in DYN 4-2 in conjunction with the CVS operator.

3/ Complete the procedure as in paragraph 3.10 and 3.11 of DYN 3-1.

TECHNOLOGY SERVICES

CHASSIS DYNAMOMETER FACILITY

GENERAL PROCEDURE DYN 4-1

ISSUE NO: 1

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DATE	ISSUE	DETAILS

GENERAL PROCEDURE DYN 4-1 -- URBAN EMISSIONS DRIVING CYCLE

The urban emissions driving cycle is a standardized procedure in which the test vehicle is driven so that the speed varies with time in a fixed way. To do this, a full line is traced on a strip chart such that the ordinates represent speed and the abscissae time. The test vehicle is driven on the dynamometer so that the pen of the recorder follows the full line, as the strip chart moves at a fixed speed. Displacement of the pen is proportional to roll speed and the vehicle thus follows the standard speed/time pattern.

Procedure:

1/ The strip chart recorder must be checked and the dynamometer set up as in DYN 3-1.

2/ Follow the procedure of DYN 3-1 up to and including Paragraph 3.8.

3/ Start the strip chart recorder and:

3.1/ If the vehicle is being preconditioned:
Start the engine and place the vehicle in gear at the points indicated on the full line trace. Drive the cold transient and stabilized portions of the cycle (1371 sec), using the accelerator and brakes to follow the trace with the pen.
At the end of the stabilized portion, turn off the engine.

3.2/ If the vehicle is being tested:

3.2.1/ Start the engine at the point indicated on the trace and signal the CVS operator through the intercom. to switch to Bag 1 at the same time.
NOTE: Give the operator enough warning before switching on -- a 5 sec countdown will do.

3.2.2/ Drive the cold transient part of the cycle, and at the point indicated on the trace (505 sec), signal the

operator to change to Bag 2. Give the operator sufficient warning as in 3.2.1.

3.2.3/ At the end of the stabilized part of the cycle, turn off the engine and signal the CVS operator to switch off Bag 2.

NOTE: The CVS operator must not turn off Bag 2 until 5 sec after the engine stops. This must be borne in mind when counting down.

3.2.4/ Turn off the main fan, stop strip chart recorder, close the hood and allow the vehicle to stand for a minimum of 9 min and a maximum of 11 min.

3.2.5/ Raise hood, turn on main fan, start strip chart recorder and at point indicated on trace, signal CVS operator to turn on Bag 3.

3.2.6/ Drive the cold transient part of the cycle and at the point indicated on the trace, turn off the engine and signal CVS operator to turn off Bag 3 -- 5 sec after engine stops.

3.3/ At end of urban emissions test, complete procedure as in Paragraph 3.10 and 3.11 of DYN 3-1.

TECHNOLOGY SERVICES

CHASSIS DYNAMOMETER FACILITY

GENERAL PROCEDURE DYN 4-2

ISSUE NO: 1

DATE: May 1984

CHANGES:

DATE	ISSUE	DETAILS

GENERAL PROCEDURE DYN 4-2 -- HIGHWAY FUEL ECONOMY TEST (HWFET) DRIVING CYCLE

The HWFET driving cycle is a standardized procedure in which the test vehicle is driven so that the speed varies with time in a fixed way. To do this, a dashed line is traced on a strip chart such that the ordinates represent speed and the abscissae time. The test vehicle is driven on the dynamometer so that the pen of the recorder follows the dashed line as the strip chart moves at a fixed speed. Displacement of the pen is proportional to the roll speed and the vehicle thus follows the standard speed/time pattern.

Procedure:

1/ The strip chart recorder must be checked and the dynamometer set up as in DYN 3-1. Ensure that the strip chart is set so that the point labelled "Start of HWFET Warm Up Cycle" is at start.

2/ Follow procedure DYN-2 and at appropriate time, start main cooling fan, switch on strip chart recorder and start engine. Immediately drive first part of HWFET cycle, following dashed trace.

3/ At end of first part of cycle (765 sec), allow engine to idle for 15 sec and, when appropriate point arrives on trace, signal CVS operator to start collecting sample (1 bag) and proceed to follow second part of cycle.
Note: Give the CVS operator adequate warning -- a 5 sec countdown -- before signalling to begin collection.

4/ At end of second part of driving cycle, switch off engine at point indicated on trace and signal operator to stop collecting sample -- 5 sec after engine stops.

5/ Complete procedure as in Paragraph 3 of DYN 3-2.

TECHNOLOGY SERVICES

CHASSIS DYNAMOMETER FACILITY

GENERAL PROCEDURE DYN 5

ISSUE NO: 1

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DATE	ISSUE	DETAILS

GENERAL PROCEDURE DYN 5 -- TESTING FOR ONTARIO MINISTRY OF ENVIRONMENT

Vehicles submitted by the Ontario Ministry of the Environment follow the normal urban emissions test routine plus a "hot start" emissions test.

Procedure:

1/ Follow the procedures of DYN 3-1 up to and including Paragraph 3.9.

2/ After urban emissions test; stop vehicle, close hood and turn off main cooling fan.

3/ Allow vehicle to soak at ambient temperature (20°C to 30°C) for a minimum of 1 h and a maximum of 2 h.

4/ At the end of the soak period; open hood, start main cooling fan, and drive cold transient and stabilized portions of urban emissions driving cycle.
Do not collect exhaust sample.

5/ At the end of the stabilized portion of cycle; stop vehicle, close hood and stop main cooling fan.

6/ Allow vehicle to soak for a minimum of 9 min and a maximum of 11 min.

7/ At the end of the soak period; open hood, start main cooling fan, and drive transient and stabilized portions of urban emissions driving cycle.
Collect exhaust sample from both portions.

8/ Complete procedure by following Paragraphs 3.10 and 3.11 of DYN 3-1.

TECHNOLOGY SERVICES

CHASSIS DYNAMOMETER FACILITY

GENERAL PROCEDURE DYN 9

ISSUE NO: 1

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CHANGES:

DATE	ISSUE	DETAILS

GENERAL PROCEDURE DYN 9 -- HOT-START URBAN EMISSIONS TEST PROCEDURE

This procedure may be used when quick, comparative tests are needed, as there is no requirement for preconditioning.

It forms part of the procedure followed for testing vehicles for the Ontario Ministry of the Environment .

This is NOT a substitute for the formal urban emissions test and may not be used or quoted as such.

Procedure:

1/ Follow the procedures of DYN 3-1 up to and including Paragraph 3.8. No preconditioning is required.

2/ Drive the cold transient and stabilized portions of the urban emissions driving cycle.

3/ At the end of the stabilized portion; stop vehicle, close hood and turn off main cooling fan.
Do not collect exhaust gas sample.

4/ Allow vehicle to soak for a minimum of 9 min and a maximum of 11 min.

5/ At end of soak period; open hood, start main cooling fan and drive cold transient and stabilized portions of urban emissions driving cycle. Collect exhaust sample from both portions.

6/ Complete procedure by following Paragraphs 3.10 and 3.11 of DYN 3-1.